

## The distribution of *Eukoenenia mirabilis* (Palpigradi: Eukoeneniidae): a widespread tramp

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**Abstract** – We report on the discovery of populations of the palpigrade *Eukoenenia mirabilis* (Grassi and Calandruccio, 1885) in South Africa and Western Australia, and compile known distributional records for the species. It is found to be widespread throughout the Mediterranean region, with additional populations occurring in Madagascar, South Africa, Chile and southern Australia. Accidental synanthropic introductions are the most likely cause of these additional records.

### INTRODUCTION

Members of the arachnid order Palpigradi represent one of the more obscure and poorly-known arachnid orders with only 79 species named in six genera and two families (Harvey 2003; Mayoral and Barranco 2002). Their phylogenetic affinities are poorly known and several competing hypotheses exist regarding their systematic placement. For example, Hammen (1977, 1989) treated palpigrades as members of the Epimerata along with the mite taxon Actinotrichida. Weygoldt and Paulus (1979) and Weygoldt (1998) regarded them as sister to Solifugae, Chelonethi (Pseudoscorpiones), Opiliones, Ricnulei and Acari. Shultz (1990) and Wheeler and Hayashi (1998) treated them as sister to the Tetrapulmonata (Araneae, Amblypygi, Schizomida and Uropygi).

The most abundant palpigrade genus, *Eukoenenia* Börner, is found in many parts of the world and is represented by over 60 species (Harvey 2003). Two species of this genus, *E. mirabilis* (Grassi and Calandruccio, 1885) and *E. florenciae* (Rucker, 1903), are widely distributed and appear to consist of largely parthenogenetic populations that have probably been inadvertently dispersed through human agency (Walter and Condé 1997). *Eukoenenia mirabilis* is widely distributed in north Africa and southern Europe, and has also been recorded from other parts of the world, including Madagascar (Rémy 1950, 1960), Chile (Condé 1974) and South Australia (Savory 1935). The Malagasy and Chilean records were made by experienced palpigrade taxonomists but there has long been suspicion regarding the identity of the Australian populations. We have examined and confirmed the

identity of the South Australian palpigrade populations and here report on the recent discovery of *E. mirabilis* in South Africa and Western Australia. We also discuss the known distribution of this species and present a distribution map depicting the known populations.

The specimens examined for this study are lodged in the South Australian Museum, Adelaide (SAM) and the Western Australian Museum, Perth (WAM). Specimens were examined with an Olympus BH-2 compound microscope by temporarily mounting the specimens on microscope slides in glycerol after clearing in very dilute lactic acid. After study they were returned to 75% ethyl alcohol in microvials.

*Eukoenenia mirabilis* (Grassi and Calandruccio, 1885)

Figures 1–4

*Koenenia mirabilis* Grassi and Calandruccio, 1885: 165.

*Eukoenenia mirabilis* (Grassi and Calandruccio): Harvey 2003: 156–157 (full synonymy).

### Material examined

**Australia: South Australia:** 1 ♀, 1 ♂ (stage B), Adelaide (SAM 1991693-4; B. Condé det.); 4 ♀, Glen Osmond [34°57'S, 138°38'E], March 1933, August 1933, 11 May 1934, H. Womersley (SAM); 4 ♀, Glen Osmond [34°57'S, 138°38'E], 27 July 1935, 4 August 1935, 3 September 1950, 9 October 1950, R.V. Southcott (SAM); 7 specimens (including 3 ♀), Glen Osmond, Birksgate [34°57'S, 138°38'E], under stones, 31 August 1975, 13 September 1975, R.V.

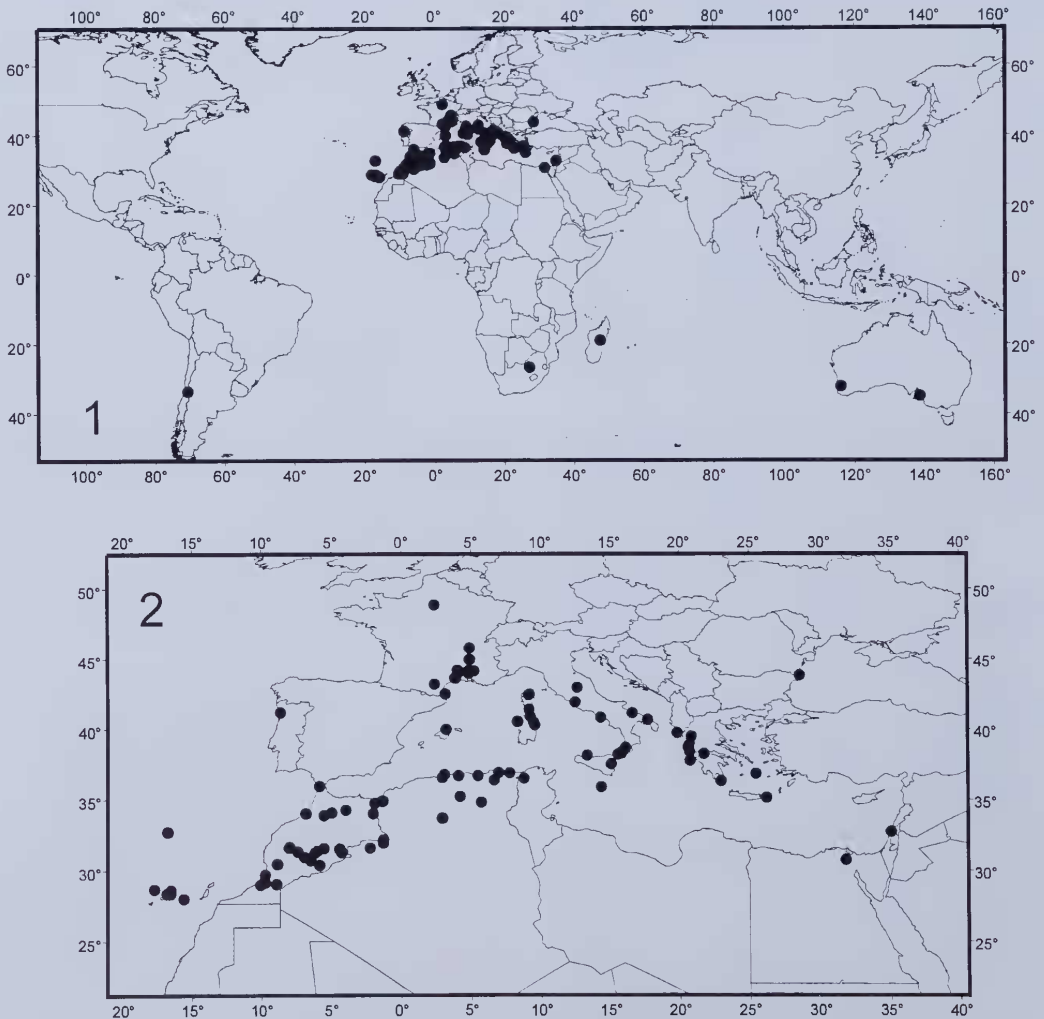
Southcott and A.M.S. (SAM); 1 ♀, Glen Osmond, Woodley Vineyard [34°57'S, 138°38'E], 16 November 1952, R.V. Southcott (SAM); 2 specimens (chelicerae only), Mt Osmond [34°57'S, 138°39'E], 16 April 1933, H. Womersley (SAM); 7 ♀, Mt Osmond [34°57'S, 138°39'E], 30 August 1953, R.V. Southcott (SAM); 7 specimens, Waterfall Gully [34°57'S, 138°40'E], north-eastern bank, pond, ex moss and soil, 1968, D.C. Lee (SAM N1991686-94); **Western Australia:** 13 ♀, Wungong Dam [32°11'41"S, 116°03'33"E], on underside of rocks embedded in soil, 26 August 2003, M.S. Harvey, F. Štáhlavský (WAM T55860-55861); 2 ♀, Wungong Dam, hillside above carpark, 32°11'38"S, 116°03'36"E, under rocks, 12 July 2004, M.S. Harvey, J. Waldock, R. Engel, T. Moulds (WAM T62256); 2 ♀, Wungong Dam, above trail to dam [32°11'40"S, 116°03'37"E], under rocks, 12 July 2004, J.M. Waldock (WAM T62259). **South**

**Africa: North-West Province:** 6 ♀, Botanical Garden, North-West University, Potchefstroom Campus [26°40'S, 27°05'E], from underside of stones, and from leaf litter, P.D. Theron (WAM 99/1082-1087).

Remarks

Identification of female specimens is confirmed by the presence of 5–6 stout glandular setae on sternites V and VI, and by the presence of a single blade in the lateral organ. This combination of features conforms to that described for *E. mirabilis* by previous authors such as Silvestri (1905) and Condé (1991), who noted very slight differences between different populations of *E. mirabilis*.

The anterolateral margin of the prosoma bears a single pair of ovoid lateral organs in specimens from all collections. These blades provide an



Figures 1–2 Maps showing known distribution records of *Eukoenia mirabilis*. 1, total records. 2, detail depicting records in Mediterranean region.

important feature for the identification of palpigrades. Multiple blades, ranging from 2 to 13 blades, in the lateral organ can be found in adults of most species of *Eukoenenia*, some species of *Koeneniodes* (*K. deharvengi*, *K. leclerci*, *K. notabilis* and *K. spiniger*) and all species of *Leptokoenenia*, *Prokoenenia* and *Triadokoenenia*. The number of blades is fairly consistent within a single species, but minor variations in blade number have been recorded, both within populations and on either side of an individual specimen. The presence of only a single blade is a feature shared by only a few species, including *E. mirabilis*, *E. angusta hindua* Condé, 1989, *E. berlesei* (Silvestri, 1903), *E. gadorensis* Mayoral and Barranco, 2002, *E. hesperia* (Rémy, 1953), *E. madeirae* Strinati and Condé, 1995, *E. necessaria* Rémy, 1960, *Allokoenenia afra* Silvestri, 1913, *Koeneniodes berndi* Condé, 1988, *K. frondiger* Rémy, 1950 (Condé 1994; Rémy 1958), *K. madecassus* Rémy 1950 (Condé 1990; Rémy 1961) and *K. malagasorum* Rémy 1960. The adults and, where known, the immatures of all known species of other palpigrade genera (*Leptokoenenia*, *Prokoenenia* and *Triadokoenenia*) bear more than one blade.

The subadult stages of two of these species (*E. mirabilis* and *Koeneniodes frondiger*) are known and, like the adults, bear a single blade in the lateral organ (Rémy 1952, 1958). Other immatures, such as *Allokoenenia?* sp. (Condé 1992), also bear a single blade only. The immature stages of some other *Eukoenenia* species bear just a single blade, but the adults bear multiple blades: *E. condei* Orghidan, Georgesco and Sârbu, 1982, *E. florenciae* (Rucker, 1903) (the "youngest known" stage), *E. lienhardi* Condé, 1989 (stage "immature A"), and various unidentified *Eukoenenia* species (Condé 1994; Rémy 1959, 1960). It may be possible that the presence of a single blade is a paedomorphic trait amongst palpigrades.

#### Distribution

*Eukoenenia mirabilis* was first recorded from Sicily (Grassi 1886; Grassi and Calandruccio 1885) and has been subsequently reported from many other localities in the Mediterranean region ranging from the Canary Islands and Madeira in the west to Israel in the east (Figures 1, 2). The most northerly records are from France but these are based upon specimens collected from artificial environments



Figures 3–4 *Eukoenenia mirabilis*, female (WAM T55860): 3, dorsal aspect. 4, lateral aspect. Note that some of the flagellum has been lost.

such as greenhouses. Outside of the Mediterranean region, *E. mirabilis* has been previously found in Chile, Madagascar and South Australia. The only Chilean record is from San Bernardo (Cekalovic 1984; Condé 1974), whilst in Madagascar, *E. mirabilis* has only been found in the vicinity of Antananarivo (Legendre 1972; Rémy 1950, 1960). *Eukoenia mirabilis* was first recorded from Australia by Savory (1935), who later (Savory 1964) stated that "...in 1933 *Koenenia mirabilis* was found on the lower slopes of Mount Osmond, Adelaide, whither it had most probably been imported." Lee and Southcott (1979) also recorded its presence in the Lofty Ranges on the outskirts of Adelaide, where it can be locally common (the late D.C. Lee, pers. comm.). MSH found many specimens of *E. mirabilis* in the collections of the South Australian Museum collected by H. Womersley, an avid and accomplished collector of minute invertebrates in the Adelaide region (Southcott 1964), the earliest of which was taken in March 1933 at Glen Osmond. These specimens appear to represent the source of Savory's record of *E. mirabilis* which were presumably conveyed to him by Womersley. Since that time many specimens have been collected by Womersley, R. Southcott and D.C. Lee in the eastern suburbs of Adelaide (see list of specimens examined above) suggesting that the species is firmly established in the area.

To these records we now add single localities from Western Australia and South Africa. The Western Australian locality is a natural eucalypt woodland situated on the outskirts of Perth dominated by Marri (*Corymbia calophylla*) with a heath understorey. The paligrades were found on the underside of stones and rocks that were deeply embedded in the surrounding soil, and the paligrades moved quickly when disturbed. The South African specimens were collected from the Potchefstroom Campus of the North-West University. The first specimens were recovered from the upper soil in an undisturbed *Acacia karroo* biotope outside of the Botanical Garden. Subsequent sampling revealed fair members of paligrades running freely on the undersides of stones. Large numbers of isotomid collembolans were noted and they are probably preyed on by the paligrades.

The discovery of *E. mirabilis* in Western Australia and South Africa, and the confirmation of the identity of the South Australian specimens demonstrates that *E. mirabilis* is more widely distributed in the southern hemisphere than previously suspected. It also suggests that it may eventually be found in other localities. For example, Forster and Forster (1999) noted the presence of at least two species of paligrades in New Zealand, but at present the specimens cannot be located (P. Sirvid, pers. comm.). Therefore, their identification remains a mystery.

All of the records from the southern continents are situated in Mediterranean climates between 18°S and 35°S, and appear to represent accidental introductions through human agency. The earliest recorded occurrence of *E. mirabilis* from outside the Mediterranean region is from Glen Osmond in 1933. The natural distribution of *E. mirabilis* in the Mediterranean region is impossible to ascertain as centuries of sea-faring trading commerce in the region have probably dispersed these small soil-dwelling animals far beyond their original natural range.

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